

# FELDSPAR AND NEPHELINE SYENITE

By Michael J. Potter

Feldspars are an aluminum silicate mineral group and occur widely in the earth's crust. The two largest end uses for processed feldspar are glass and ceramics. In glassmaking, feldspar provides alumina, which improves hardness, durability, and resistance of glass to chemical corrosion. In the ceramic industry, feldspar is used in ceramic bodies and glazes. As a flux, the mineral lowers the vitrifying temperature of a ceramic body during firing and forms a glassy phase in the body.<sup>1</sup>

## Production

U.S. production of marketable feldspar (including aplite) in 1994 was 765,000 metric tons (mt) with a value of \$31.2 million, according to the U.S. Bureau of Mines (USBM). Feldspar was mined in seven States, led by North Carolina, and followed, in descending order, by Virginia, Oklahoma, Georgia, California, Idaho, and South Dakota. North Carolina accounted for about 65% of the total. Ten U.S. companies operated 11 beneficiating plants and 1 grinding plant. North Carolina had five operations; the other six States listed above each had one. The grinding plant was in South Carolina.

Domestic production data for feldspar were developed by the USBM by means of a voluntary survey. Of the 11 active beneficiation plants, data were obtained from 8 by the close-out date, representing 73% of the total plants canvassed. The eight respondents reported a production of about 640,000 mt or 84% of the total domestic production shown in table 1. The estimated production of the nonrespondents, about 125,000 mt, was derived from past years' production levels and trends.

The Feldspar Corp. continued with its program to increase capacity for all products at its Spruce Pine, NC, operation. Franklin Industrial Minerals Co. of Nashville, TN, acquired 100% of KMG Minerals Inc., the largest U.S. producer of dry ground mica. KMG is also a producer of floated silica and potash feldspar. Franklin, a division of Franklin Industries Inc., merged its existing mica operations in Verlarde, NM, with KMG to form the KMG Minerals Div.<sup>2</sup>

## Consumption

Sixty-three percent of feldspar (including aplite) sold or used in the United States went into glass, including glass containers and glass fiber. Feldspar going into pottery and other uses was 37% of the output.

## World Review

**Capacity.**—The data in table 8 are rated capacity as of December 31, 1994. Rated capacity is defined as the maximum quantity of product that can be produced in a period of time on a normally sustainable long-term operating rate, based on the physical equipment of the plant, and given acceptable routine operating procedures involving labor, energy, materials, and maintenance. Capacity includes both operating plants and plants temporarily closed that, in the judgement of the author, can be brought into production within a short period of time with minimum capital expenditure. Because actual capacity data were not available, recent peak production during the past 5 years for the United States and foreign countries was considered to be equal to rated capacity.

In Australia, Minerals Corp. Ltd. commissioned a processing plant at Broken Hill, NSW. Feldspar reserves were put in excess of 2 million mt. Products included soda spar, potash spar, mixed soda-potash spar and aplite. Exports of ceramic grade feldspar to southeast Asia were anticipated in 1995.<sup>3</sup>

In Greece, quartz and feldspar producer Meviar SA was purchased by Dr. Eng. G. Georgiades for about \$1.6 million. The processing plant, 26 kilometers north of Thessaloniki, was producing 16,000 mt per year of feldspar and 5,000 mt per year of quartz. Feldspar sales were equally divided between the domestic ceramic market and the Italian tile industry.<sup>4</sup>

In Malaysia, Commercial Minerals (Malaysia) Sdn Bhd, a subsidiary of Australia-based Commercial Minerals Ltd., started production of glass-grade potash feldspar at its plant at Pasir Gudang. Raw material for the operation was being supplied by Commercial's Pippingarra potash feldspar mine in northwest Australia.<sup>5</sup>

In the United Kingdom, Appleby Calumite Ltd. completely rebuilt its plant to process blast

furnace slag, a byproduct from ironmaking, into Calumite. Calumite is basically lime, silica, and alumina in a vitreous form. Since it is already in a glassy phase and fuses easily, it results in fuel and energy savings in a glass batch. In 1994, over 60,000 mt of Calumite was sold, with 10,000 mt being exported. In the United Kingdom, glass containers were the largest user.<sup>6</sup>

## Outlook

Glass containers have been the largest end use of feldspar in the United States. Shipments of glass containers in 1995 may be down about 3% after a slight decrease in 1994.<sup>7</sup> Glass bottles continue to face competition from plastic, metal, and paper containers. Recycled glass (cullet) is an ongoing part of the raw material consumed in glassmaking. Total housing starts in 1995 may be about the same as in 1994 (1.4 million). Housing starts in 1994 were about 9% higher than in 1993, resulting in demand for plumbing fixtures, glass fiber insulation, and tile. Residential remodeling was projected to show an increase of around 5% in 1994 and 1995.<sup>8</sup>

## Nepheline Syenite

In Canada, nepheline syenite was produced by Unimin Canada Ltd. at Blue Mountain near Peterborough, Ontario. End uses included container glass, glass fiber insulation, ceramic whiteware, wall and floor tile, and as a filler-extender in paints, plastics, and foam rubber.

More than 75% of Canadian nepheline syenite output typically has been exported to the United States.<sup>9</sup>

Prices for Canadian nepheline syenite at yearend 1994 were approximately \$21 per mt to \$23 per mt, glass grade, 30 mesh, bulk, car lots/truck lots, depending on iron content; and \$67 per mt for ceramic grade, 200 mesh, bagged, 1-ton lots.<sup>10</sup>

In Norway, North Cape Nefelin A/S changed its name to North Cape Minerals AS. The company produced nepheline syenite at an underground mining operation on the arctic island of Stjernøya. About 80% of the output was used for glass and about 15% went into ceramic applications. More than 90% of the production was exported to Western Europe.<sup>11</sup>

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<sup>1</sup>Kauffman, R.A. and D. Van Dyk. Feldspars. Ch. in Industrial Minerals and Rocks, 6th ed., 1994, p. 478.

<sup>2</sup>Industrial Minerals (London). World of Minerals. No. 326, Nov. 1994, p. 14.

<sup>3</sup>———. No. 322, July 1994, p. 8.

<sup>4</sup>———. No. 321, June 1994, p. 12.

<sup>5</sup>———. p. 15.

<sup>6</sup>Glass. Iron Makers' Waste is Glass Makers' Gain. V. 71, No. 12, Dec. 1994, p. 466.

<sup>7</sup>Ceramic Industry. Business Outlook. V. 143, No. 7, Dec. 1994, p. 15.

<sup>8</sup>———. Economic Forecast 1994-95. V. 143, No. 3, Aug. 1994, pp. 38-39.

<sup>9</sup>Guillet, G. R. Nepheline Syenite. Ch. in Industrial Minerals and Rocks, 6th ed., 1994, p. 719.

<sup>10</sup>Industrial Minerals (London). Prices. No. 327, Dec. 1994, p. 63.

<sup>11</sup>Work cited in footnote 9.

TABLE 1  
SALIENT FELDSPAR AND NEPHELINE SYENITE STATISTICS 1/

		1990	1991	1992	1993	1994
United States:						
Feldspar:						
Produced 2/	metric tons	630,000	580,000	725,000	770,000	765,000
Value	thousands	\$28,500	\$26,000	\$28,500	\$31,400	\$31,200
Exports	metric tons	24,800	8,430	17,700	17,700	17,300
Value	thousands	\$2,170	\$1,330	\$2,210	\$1,840	\$1,940
Imports for consumption	metric tons	11,300	17,900	13,000	7,050	7,360
Value	thousands	\$723	\$1,120	\$923	\$514	\$513
Nepheline syenite:						
Imports for consumption	metric tons	276,000	289,000	335,000	289,000	333,000
Value	thousands	\$12,200	\$13,100	\$14,700	\$15,400	\$18,700
Consumption, apparent 3/ (feldspar plus nepheline syenite)	thousand metric tons	893	878	1,060	1,050	1,088
World: Production (feldspar)	do.	5,990 r/	5,700 r/	6,090 r/	6,390 r/	6,250 e/

e/ Estimated. r/ Revised.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits.

2/ Includes hand-cobbed feldspar, flotation-concentrate feldspar, feldspar in feldspar-silica mixtures and aplite; includes potash feldspar (8% K<sub>2</sub>O or higher).

3/ Production plus imports minus exports.

TABLE 2  
FELDSPAR PRODUCED IN THE UNITED STATES 1/

(Thousand metric tons and thousand dollars)

Year	Flotation concentrate		Other 2/		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1993	366	15,600 r/	407	15,800	770	31,400
1994	384	16,400	381	14,800	765	31,200

r/ Revised.

1/ Previously published and 1994 data rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

2/ Includes hand-cobbed, feldspar-silica mixtures (feldspar content), and aplite.

TABLE 3  
PRODUCERS OF FELDSPAR AND FELDSPATHIC MATERIALS IN 1994

Company	Plant location	Product
APAC Arkansas Inc.	Muskogee, OK	Feldspar-silica mixture.
Corona Industrial Sand Co.	Corona, CA	Do.
The Feldspar Corp.	Monticello, GA	Potash feldspar.
Do.	Spruce Pine, NC	Soda-potash feldspar.
FMC Lithium Div.	Bessemer City, NC	Feldspar-silica mixture.
KMG Minerals, Inc.	Kings Mountain, NC	Potash feldspar.
KT Feldspar Corp.	Spruce Pine, NC	Soda-potash feldspar.
Pacer Corp.	Custer, SD	Potash feldspar.
Spartan Minerals Corp.	Pacolet, SC	Feldspar-silica mixture.
Unimin Corp.	Emmett, ID	Do.
Do.	Spruce Pine, NC	Soda-potash feldspar.
U.S. Silica	Montpelier, VA	Aplite.

TABLE 4  
FELDSPAR 1/ 2/ SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY USE

(Thousand metric tons and thousand dollars)

Use	1993		1994	
	Quantity	Value	Quantity	Value
<b>Flotation concentrate:</b>				
Glass	138	6,650	128	6,430
Pottery	238	14,600	243	14,900
Total	376	21,200	371	21,300
<b>Other 3/</b>				
Glass	366	17,200	341	16,800
Pottery	W	W	W	W
Miscellaneous	W	W	W	W
Total	394	19,990	379	20,000
<b>Total:</b>				
Glass 4/	504	23,900	469	23,200
Pottery	W	W	W	W
Miscellaneous	W	W	W	W
Total	770	41,100	750	41,300

W Withheld to avoid disclosing company proprietary data; included in " Total."

1/ Includes potash feldspar (8% K<sub>2</sub>O or higher).

2/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

3/ Includes hand-cobbed, feldspar-silica mixtures (feldspar content), and aplite.

4/ Includes container glass and glass fiber.

TABLE 5  
PRICES FOR FELDSPAR

(Dollars per metric ton, f.o.b. plant, bulk)

Producing States	1994
<b>Ceramic grade:</b>	
Monticello, GA, 200 mesh, potash	105
Spruce Pine, NC, 170 to 250 mesh, soda	66-68
<b>Glass grade:</b>	
Monticello, GA, 80 mesh, potash	88
Spruce Pine, NC, 30 mesh, soda	46

Source: Industrial Minerals (London), No. 327, Dec. 1994, p. 62.

TABLE 6  
U.S. EXPORTS OF FELDSPAR, BY COUNTRY 1/

Country	1993		1994	
	Quantity (metric tons)	Value	Quantity (metric tons)	Value
Canada	1,540	\$172,000	1,630	\$203,000
Dominican Republic	505	47,700	--	--
Guatemala	498	41,300	--	--
Italy	2,040	397,000	510	108,000
Mexico	5,990	330,000	11,800	973,000
Taiwan	5,370	589,000	1,810	239,000
Thailand	--	--	654	138,000
Venezuela	953	68,000	--	--
Other	791	190,000	888	275,000
Total	17,700	1,840,000	17,300	1,940,000

1/ Previously published and 1994 data rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 7  
U.S. IMPORTS FOR CONSUMPTION OF FELDSPAR, BY COUNTRY 1/

Country	1993		1994	
	Quantity (metric tons)	Value 2/	Quantity (metric tons)	Value 2/
Mexico	6,940	\$468,000	7,210	\$468,000
Other	118	46,100	141	45,700
Total	7,050	514,000	7,360	513,000

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

2/ Customs value.

Source: Bureau of the Census.

TABLE 8  
WORLD FELDSPAR ANNUAL PRODUCTION  
CAPACITY, DECEMBER 31, 1994

(Thousand metric tons)

	Rated capacity 1/
<b>North America:</b>	
Mexico	163
United States	770
Total	933
<b>South America:</b>	
Brazil	145
Colombia	78
Venezuela	230
Other	95
Total	548
<b>Europe:</b>	
Finland	53
France e/	420
Germany e/	410
Italy	1,690
Norway e/	100
Poland e/	138
Portugal e/	45
Romania	88
Russia e/	100
Spain	239
Uzbekistan e/	80
Other	86
Total	3,460
<b>Africa:</b>	
South Africa, Republic of	70
Other	46
Total	116
<b>Asia and Oceania:</b>	
India	68
Iran	65
Japan	89
Korea, Republic of	539
Thailand	703
Turkey	520
Other e/	82
Total	2,070
World total	7,120

e/ Estimated.

1/ Includes capacities of operating plants as well as plants on standby basis.

2/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

TABLE 9  
FELDSPAR: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1990	1991	1992	1993	1994 e/
Argentina	28,000 r/	42,300 r/	48,500 r/	55,800 r/	50,000
Australia e/	16,000	16,000	15,000	15,000	16,000
Austria	8,790	10,400	11,100	8,490 r/	8,500
Brazil	105,000	119,000	140,000	145,000 r/	145,000
Burma 4/	2,560 r/	3,740 r/	1,620 r/	6,290 r/	4,000
Chile	2,980	4,010	5,740	4,150 r/	4,150
Colombia	34,800	45,600	78,400 r/	60,500 r/	70,000
Ecuador	8,130	5,010	3,250	3,300 e/	3,000
Egypt	9,890	32,600	32,000 e/	38,900 r/ e/	38,000
Finland	52,600	53,000	47,500	51,500 r/	51,500
France e/	420,000	400,000	282,000	274,000 r/	300,000
Germany:					
Eastern states (sand, including stone)	80,000 e/	XX	XX	XX	XX
Western states	338,000	XX	XX	XX	XX
Total e/	418,000	404,000	385,000	360,000 r/	350,000
Guatemala	11,900	6,960	8,050	7,500 e/	7,600
Hong Kong	3,820	--	--	--	--
India	54,100	65,100	67,700 r/	66,400 r/	67,000
Iran	32,100	64,800	52,100	25,000 r/	30,000
Italy	1,610,000	1,300,000	1,690,000	1,600,000 e/	1,600,000
Japan 5/	57,900	88,500	72,300 r/	71,600 r/	53,000
Kenya e/	1,290 6/	1,200	1,200	1,200	1,200
Korea, Republic of	237,000	248,000	282,000	539,000 r/	500,000
Macedonia e/	XX	XX	20,000	15,000	15,000
Mexico	163,000	152,000	160,000 r/	124,000 r/	130,000
Morocco e/	1,000	1,000	1,000	1,000	1,000
Nigeria e/	714 6/	700	700	700	700
Norway e/ 7/	90,000	90,000	100,000	100,000	100,000
Pakistan	10,200	10,200	19,200	17,000	17,000
Peru	10,000	3,000	10,000	10,000 e/	10,000
Philippines	168,000 r/	48,000	45,000 e/	24,200 r/	30,000
Poland	32,000 r/	138,000 r/	34,000 r/	35,000 r/ e/	35,000
Portugal e/	44,000 6/	45,000	40,000	45,000	45,000
Romania	45,000 e/	40,000 e/	27,700	87,700 r/	45,000
Russia e/	XX	XX	100,000	70,000	55,000
Serbia and Montenegro	XX	XX	5,110	2,680 r/	2,800
South Africa, Republic of	56,100	70,300	49,400	56,800 r/	47,200 6/
Spain 8/	214,000	192,000	204,000	239,000 r/	200,000
Sri Lanka	9,700	9,910	7,520	8,000 e/	8,100
Sweden	41,200	32,900	34,600 r/	30,000	30,000
Taiwan	7,320	1,340	2,220	2,100 r/	800
Thailand	311,000	703,000	560,000	601,000 r/	600,000
Turkey	182,000	230,000	465,000	520,000 r/	500,000
U.S.S.R. e/ 9/	300,000	250,000	XX	XX	XX
United Kingdom (china stone)	6,260	6,420	8,240 r/	6,570 r/	7,000
United States	630,000	580,000	725,000	770,000	765,000 6/
Uruguay e/	3,000	3,000	3,000	3,000	3,000
Uzbekistan e/	XX	XX	80,000	70,000	70,000
Venezuela	91,000	138,000	169,000	220,000 r/	230,000
Yugoslavia 10/	43,500	40,000	XX	XX	XX
Zambia	60	70 e/	113	100 e/	100
Zimbabwe	2,200	3,820	2,700	1,550 r/	2,000
Total	5,990,000 r/	5,700,000 r/	6,090,000 r/	6,390,000 r/	5,480,000

e/ Estimated. r/ Revised. XX Not applicable.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

2/ Table includes data available through Apr. 25, 1995.

3/ In addition to the countries listed, former Czechoslovakia, Madagascar, and Namibia produce feldspar, but output is not officially reported, and available general information is inadequate for the formulation of reliable estimates of output levels.

4/ Data are for fiscal years beginning Apr. 1 of that stated.

5/ In addition, the following quantities of aplite ore were produced in metric tons: 1990--523,000; 1991--500,000

1992--416,000; 1993--404,000 (revised); and 1994--385,000 (estimated).

6/ Reported figure.

7/ Excludes nepheline syenite.

8/ Includes pegmatite.

9/ Dissolved in Dec. 1991; however, information for 1992-94 is inadequate to formulate reliable estimates for individual countries other than those listed in this table.

10/ Dissolved in Apr. 1992.

TABLE 10  
U.S. IMPORTS 1/ 2/ FOR CONSUMPTION OF NEPHELINE SYENITE

Year	Quantity (metric tons)	Value 3/ (thousands)
1993	289,000	\$15,400
1994	333,000	18,700

1/ Crude and ground combined.

2/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits.

3/ Customs value.

Source: Bureau of the Census.